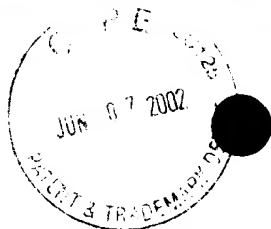


PATENT



DT01 Rec'd PCT/PTO JUN 07 2002

Docket No.: EHAR0010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of : TERUYUKI NAKANO et al.

Application No. : 09/856,402

Filed : May 21 2001

For : POLISHING MACHINE FOR
PERIPHERAL EDGE OF
SEMICONDUCTOR

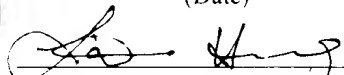
Examiner :

Certificate of Mailing

I hereby certify that this correspondence and all marked attachments are being deposited with the United States Postal Service as express mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on

June 07, 2002

(Date)


Jiawei Huang, Reg. No. 48,330

RENEWED PETITION UNDER 37 CFR 1.47(a)

ATTN: PCT LEGAL OFFICE

BOX PCT

ASSISTANT COMMISSIONER FOR PATENTS

WASHINGTON, D.C. 20231

Dear Sir:

In response to the Decision on Petition of Application Under 37 CFR 1.47(a), which was mailed by the Patent and Trademark Office on February 05, 2002, enclosed are:

- (X) Petition under 37 CFR 1.47(a).
- (X) Declaration of Yasuhiro Kozawa.
- (X) A Declaration and Power of Attorney executed by inventor(s).
- () An extension of time to respond for __ month(s) is hereby requested.

Time Extension Fee:

- () One month (\$110 large entity)
- () Two months (\$400 large entity)
- () Three months (\$920 large entity)

- (X) A copy of Notification of Missing Requirements.
- (X) A copy of Decision of Petition.
- (X) English Translation of Evidences.
- (X) Evidences 1-3.
- (X) A copy of previous filed response to missing requirement is enclosed.
- (X) Request for refund

OTHER ITEMS

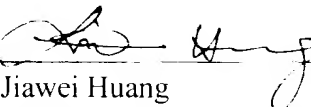
- (X) Return prepaid postcard.
(X) Fees as calculated below:

Surcharge for Declaration 37CFR 1.47(a)	\$ 130	\$ 130
For a Large entity:	TOTAL FILING FEE	\$ 130

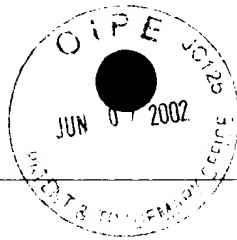
- (X) A check in the amount of **\$130** cover the above fees is enclosed.
- (X) The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment, to Account No. 50-0710 (Order No. EHAR0010). A duplicate copy of this sheet is enclosed.

Respectfully submitted,
J.C. PATENTS,

Dated: 6/7/2002

By: 
Jiawei Huang
Registration No. 43,330

4 Venture, Suite 250
Irvine, Ca. 92618
(949) 660-0761



In re application of:)
Application No.: 09/856,402)
Filed: May 21, 2001)
For: POLISHING MACHINE FOR PERIPHERAL)
EDGE OF SEMICONDUCTOR)

Examiner:)
Art Unit:)

**PETITION FOR FILING BY A PERSON NOT THE INVENTOR
UNDER 37 CFR 1.47 (a)**

ATTN.: PCT Legal Office
Box PCT
ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

Sir:

This is a petition to accept the above-identified application without the signatures of joint inventor, Hitoshi Tambo.

Applicant submitted a petition under 37 CFR 1.27(a) on October 9, 2001 (a complete copy of the petition and other papers filed with the petition is enclosed herewith). The petition of October 9, 2001 was dismissed without prejudice (a copy of DECISION ON PETITION UNDER 37 CFR 1.47(a) mailed on February 5, 2002 is enclosed herewith).

The present petition cures the deficiencies of the petition of October 9, 2001 and provides additional evidence. Thus, reconsideration of the petition of October 9, 2001 is requested.

Evidence 1 is a letter sent on August 22, 2001 to inform Mr. Tambo of the filing of the application in U.S. and to request his signatures.

Evidence 2 is a delivery certificate showing that the letter of "evidence 1" was received by Mr. Tambo on August 26, 2001.

Evidence 2-2 is a delivery certificate showing that the formal documents and the complete specification including the claims and the drawings (which are attached to "evidence 2-2") sent on August 22, 2001 with a registered letter was received by Mr. Tambo on August 26, 2001. (Note: here the "specification" is the English translation (as filed in the U.S.) of the original international application. Mr. Tambo certainly has reviewed the original specification when filing the international application.)

Evidence 3 is a letter from Mr. Tambo dated September 9, 2001, stating he will return the documents without signing them.

As evidenced by the DECLARATION OF YASUHIRO KOZAWA and the attached "evidence 1", "evidence 2", "evidence 2-2", and "evidence 3" (of which English translations are also enclosed herewith), diligent effort has been made to present a copy of the application papers (specification, including claims, drawings, and oath or declaration) to the inventor, Hitoshi Tambo, of the above-identified application. But Mr. Tambo refused to sign the declaration.

According to the employment agreement, all intellectual property rights of Tambo's inventions made during his employment at Kabushiki Kaisha Ishii Hyoki have been assigned, or under obligation to be assigned, to Kabushiki Kaisha Ishii Hyoki. Accordingly, the other inventors, Teruyki Nakano; and Yasuhiro Kozawa, of the above-identified application, made the application for patent on behalf of Hitoshi Tambo under 37 C.F.R. 1.47(a) so as to preserve the assignee's rights.

The last known address of Hitoshi Tambo is:

4-7-9, Eda-Nisi, Aoba-Ku,
Yokohama-shi, Kanagawa-ken, Japan

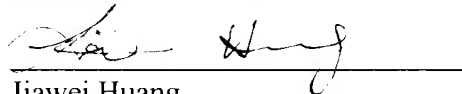
The required fee \$130 under 37 C.F.R. 1.17(h) is enclosed.

In the DECISION ON PETITION UNDER 37 CFR 1.47(a) mailed on February 5, 2002, the Examiner indicated that "the declaration is executed by Yasuhiro Kozawa, whereas the international application lists the inventor as Yasuhiro Kosawa." The Examiner is thanked for pointing out this inconsistency. Applicant would like to clarify that "Yasuhiro Kozawa" is the correct name. A petition to correct the inventor's name from Yasuhiro Kosawa to Yasuhiro Kozawa was already filed with Japan Patent Office (JPO) on February 8, 2001. According to JPO's rule, official document showing the above name change is not available to applicant. Thus, Applicant is not able to provide a copy of such document with U.S. Patent and Trademark Office.

Date: 6/7/2002

4 Venture, Suite 250
Irvine, CA 92618
(949) 660-0761

Respectfully submitted,



Jiawei Huang
Registration No. 43,330

**DECLARATION AND POWER OF ATTORNEY - USA PATENT APPLICATION
(37 CFR 1.63)**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

POLISHING MACHINE FOR PERIPHERAL EDGE OF SEMICONDUCTOR

the specification of which:

- (a) ☐ is attached hereto; or
(b) ☒ was described and claimed in PCT International Application No. PCT/JP00/07229 filed on 10/18/00 (MM/DD/YY) and as amended under PCT Article 19 on _____ (if any) and/or under PCT Article 34 on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above;

I acknowledge the duty to disclose information which is material to the patentability as defined in 37 CFR 1.56;

I hereby claim foreign priority benefits under 35 U.S.C. 119 (a)-(d) or 365(b) of any foreign application(s) for patent, design or inventor's certificate, or 365(a) of any PCT international application(s) which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN APPLICATION(S):

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (MM/DD/YY)	PRIORITY CLAIMED
JP	11-295847	10/18/99	YES
JP(PCT)	PCT/JP00/07229	10/18/00	YES

POWER OF ATTORNEY:

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Jiawei Huang (Reg. No. 43,330)

Charles C.H. Wu (Reg. No. 39, 081)

Maria Erlinda C. Sarno (Reg. No. 37,436)

Belinda Lee (Reg. No. 46, 8632)

SEND CORRESPONDENCE TO:

J.C. Patents, Inc.
1340 Reynolds Ave., Suite 114
Irvine, California 92614
(949) 660-0761

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

Jiawei Huang
(949) 660-0762

DECLARATION AND POWER OF ATTORNEY -CONTINUED

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: TERUYUKI NAKANOInventor's signature: Date: 10. JULY, 2001

Citizenship: JAPAN

Residence and Post Office Address: 5, ASAHIGAOKA, KANNABECHO, FUKAYASU-GUN, HIROSHIMA 720-2113, JAPAN.

Full name of second inventor: YASUHIRO KOZAWA

Inventor's signature: Date: 10. JULY, 2001

Citizenship: JAPAN

Residence and Post Office Address: 5, ASAHIGAOKA, KANNABECHO, FUKAYASU-GUN, HIROSHIMA 720-2113, JAPAN.

Full name of third inventor: HITOSHI TAMBO

Inventor's signature: _____ Date: _____

Citizenship: JAPAN

Residence and Post Office Address: 5, ASAHIGAOKA, KANNABECHO, FUKAYASU-GUN, HIROSHIMA 720-2113, JAPAN.

ASSIGNMENT

WHEREAS, the inventors: TERUYUKI NAKANO
 YASUHIRO KOZAWA
 HITOSHI TAMBO

hereafter referred to as ASSIGNOR, has/have invented certain new and useful improvements as described and set forth in the below identified application for United States Letters Patent:

Title: **POLISHING MACHINE FOR PERIPHERAL EDGE OF SEMICONDUCTOR**

[X] Filed: May 21, 2001

Serial No.:

] Executed concurrently with the execution of this instrument

AND WHEREAS, KABUSHIKI KAISHA ISHII HYOKI (hereinafter "ASSIGNEE"),
Residing at 5, ASAHIGAOKA, KANNABECHO, FUKAYASU-GUN, HIROSHIMA 720-
 2113, JAPAN.

desires to acquire the entire right, title, and interest in and to the said improvements and the said application and in any U.S. Letters Patent which may be granted on the same:


NOW, THEREFORE, for good and valuable consideration, the receipt of which is acknowledged, I/we, the inventor(s), have sold, assigned and transferred, and by these presents do sell, assign and transfer unto said ASSIGNEE, and ASSIGNEE'S successors and assigns, the entire right, title, and interest in and to the said improvements, and said application, and all divisions, renewals and continuations thereof in the United States, and the entire right, title, and interest in and to any and all Patents which may be granted therefor and all reissues and extensions thereof in the United States, I/we hereby authorize and request the Commissioner of Patents and Trademarks to issue said United States Patent for said improvements to said ASSIGNEE, its/his successors, legal representatives and assigns, for his sole use and behoof; and for the use and behoof of its/his successors, legal representatives and assigns, to the full end of the term for which said Patent may be granted, as fully and entirely as the same would have been held by said Assignor had this assignment and transfer not been made.

AND I/WE HEREBY covenant and agree that I/we will, without charge to said ASSIGNEE, but at ASSIGNEE'S expense, communicate to said ASSIGNEE, its/his successors, legal representatives and assigns, any facts known to us respecting said improvements, and testify in any legal proceeding, sign all lawful papers, execute all divisional, continuing and reissue applications, make all rightful oaths and generally do everything possible to aid said ASSIGNEE, its/his successors, legal representatives and assigns, to obtain and enforce proper patent protection for said improvements.

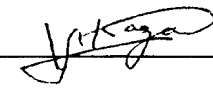
ASSIGNMENT CONTINUED

IN TESTIMONY WHEREOF, Assignor has/have signed his/their name(s) on the date(s) indicated.

Full name of the sole or first inventor: TERUYUKI NAKANO

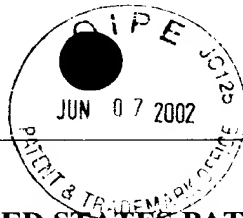
Inventor's signature:  Date: 10. JULY, 2001

Full name of the second inventor: YASUHIRO KOZAWA

Inventor's signature:  Date: 10. JULY, 2001

Full name of the second inventor: HITOSHI TAMBO

Inventor's signature: _____ Date: _____



PATENT
Docket No. «IMPORT_CASE_JCPI_DOCKET_NO»

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: TERUYUKI NAKANO et al.)
Application No. 09/856,402)
Filed: May,21,2001)
For: POLISHING MACHINE FOR)
PERIPHERAL EDGE OF)
SEMICONDUCTOR)
Attorney Docket No. EHAR0010)

DECLARATION OF YASUHIRO KOZAWA

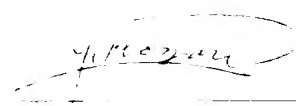
I, Yasuhiro Kozawa, do hereby declare that:

1. I am the manager of project head office of Kabushiki Kaisha Ishii Hyoki, a company located at 5, Asahigaoka, Kannabecho, Fukayasu-gun, Hiroshima 720-2113, Japan.
2. I am aware that the above-identified application names as joint inventors: Teruyki Nakano; Yasuhiro Kozawa; and Hitoshi Tambo.
3. I am aware that Mr. Hitoshi Tambo was hired by Kabushiki Kaisha Ishii Hyoki on April 10, 2000 as an engineer and retired on May 20, 2001. I am further aware that, while working at Kabushiki Kaisha Ishii Hyoki, Mr. Tambo contributed to the development of the invention disclosed and claimed in the above-identified application.
4. I am aware that Mr. Tambo's last known address at the time he retired from Kabushiki Kaisha Ishii Hyoki was 4-7-9, Eda-Nisi, Aoba-Ku, Yokohama-shi, Kanagawa-ken, Japan.
5. I am aware that, according to the employment agreement, all intellectual property rights of Mr. Tambo's inventions made during his employment at Kabushiki Kaisha Ishii Hyoki have been assigned, or under obligation to be assigned, to Kabushiki Kaisha Ishii Hyoki.
6. Kabushiki Kaisha Ishii Hyoki has attempted to contact Mr. Tambo by mail and telephone to obtain his signature on the documents (the Declaration and Power of Attorney, and the Assignment). More particularly:
 - a) I, on behalf of Kabushiki Kaisha Ishii Hyoki, sent Mr. Tambo a contents-certified mail dated August 22, 2001 to inform him of the

filling of the above identified application and to request him to execute the documents. (See the attached copy of the receipt of the contents certificate labeled as "evidence 1").

- b) The contents-certified mail was delivered to Mr. Tambo on August 26, 2001. (See the attached copy of the delivery certificate labeled as "evidence 2").
 - c) I also sent Mr. Tambo a registered letter dated August 22, 2001 with the documents attached to the complete specification including claims and drawings of the above-identified application.
 - d) The registered letter was delivered to Mr. Tambo on August 26, 2001. (See the attached copy of the delivery certificate labeled as "evidence 2-2").
 - e) After receiving the returned delivery certificates, I tried to contact Mr. Tambo by telephone on August 30, and September 5, 2001.
 - d) I succeeded in contacting with Mr. Tambo by telephone on September 5, 2001, and requested him to review the specification and sign the documents. In response, Mr. Tambo told me that he would not sign the documents.
 - e) I received a letter dated September 9, 2001 from Mr. Tambo with the documents returned without his signature. (See the attached copy of Mr. Tambo's letter labeled as "evidence 3").
7. Based on my present knowledge, the specification including claims and drawings of the above-identified application has been presented to Mr. Tambo. I believe Mr. Tambo fully understand the content of the above mentioned documents presented to him. Mr. Tambo has refused to sign the Declaration and Power of Attorney.
8. I declare that all the statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application and any patent issued thereon.

Dated Aug 29 2002

By 
Yasuhiro Kozawa
Manager
Kabushiki Kaisha Ishii Hyoki



UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patent and Trademark
United States Patent and Trademark Office
Washington, D.C. 20231
www.uspto.gov

U.S. APPLICATION NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
09/856402	NAKANO	K E HAR0010
INTERNATIONAL APPLICATION NO.		
PCT/JP00/07229		
1A FILING DATE	PRIORITY DATE	
18 OCT 00	18 OCT 99	

J C PATNETS
1340 REYNOLDS AVENUE SUITE 114
IRVINE, CA 92614

DATE MAILED 21 JUN 2001

NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

1. The following items have been submitted by the applicant or the IB to the United States Patent and Trademark Office as ☐ a Designated Office (37 CFR 1.494) ☐ an Elected Office (37 CFR 1.495):

- | | |
|---|--|
| <input checked="" type="checkbox"/> U.S. Basic National Fee. | <input checked="" type="checkbox"/> Indication of Small Entity Status. |
| <input checked="" type="checkbox"/> Copy of the international application. | <input checked="" type="checkbox"/> Translation of the international application into English. |
| <input type="checkbox"/> Oath or Declaration of inventors(s). | <input type="checkbox"/> Translation of Article 19 amendments into English. |
| <input type="checkbox"/> Copy of Article 19 amendments. | <input type="checkbox"/> Other: |
| <input checked="" type="checkbox"/> Priority Document. | |
| <input type="checkbox"/> The International Preliminary Examination Report in English and its Annexes, if any. | |
| <input type="checkbox"/> Translation of Annexes to the International Preliminary Examination Report into English. | |

2. ☐ Applicant has requested early processing under 35 U.S.C. 371(f) but has not filed the following indicated items and/or the indicated items in paragraph 3 below. The Basic National Fee and the copy of the international application must be filed prior to 20 or 30 months from the priority date to avoid abandonment

- | | |
|---|---|
| <input type="checkbox"/> U.S. Basic National Fee. | <input type="checkbox"/> Copy of the international application. |
|---|---|

3. The following items **MUST** be furnished within the period set forth below in order to complete the requirements for acceptance under 35 U.S.C. 371:

- | |
|--|
| <input type="checkbox"/> a. Translation of the application into English. A processing fee will be required if submitted later than the appropriate 20 or 30 months from the priority date. |
| <input type="checkbox"/> The current translation is defective for the reasons indicated on the attached Notice of Defective Translation. |
| <input type="checkbox"/> b. Processing fee for providing the translation of the application and/or the Annexes later than the appropriate 20 or 30 months from the priority date (37 CFR 1.492(f)). |
| <input checked="" type="checkbox"/> c. Oath or declaration of the inventors, in compliance with 37 CFR 1.497(a) and (b), properly identifying the application (preferably by the International application number and international filing date). A surcharge will be required if submitted later than the appropriate 20 or 30 months from the priority date. |
| <input type="checkbox"/> The current oath or declaration does not comply with 37 CFR 1.497(a) and (b) for the reasons indicated on the attached PCT/DO/EO/917. |
| <input checked="" type="checkbox"/> d. Surcharge for providing the oath or declaration later than the appropriate 20 or 30 months from the priority date (37 CFR 1.492(e)). |

4. Additional claim fees of \$ _____ as a ☒ large entity ☐ small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due (37 CFR 1.492(g)). See attached PTO-875.

5. ☐ Applicant has not submitted the required sequence listing pursuant to 37 CFR 1.821-1.825. See attached PCT/DO/EO/920.

ALL OF THE ITEMS SET FORTH IN 3(a)-3(d), 4 AND 5 ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE OR BY 22 OR 32 MONTHS (where 37 CFR 1.495 applies) FROM THE PRIORITY DATE FOR THE APPLICATION, WHICHEVER IS LATER. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.137(a).

6. If box 3a or 3c is checked, a translation of the Annexes **MUST** be submitted no later than the time period set above or the Annexes will be cancelled. A processing fee will be required if submitted later than 20 or 30 months from the priority date.

7. The Article 19 amendments are cancelled since a translation was not provided by the appropriate 20 (37 CFR 1.494(d)) or 30 (37 CFR 1.495(d)) months from the priority date.

Applicant is reminded that any communication to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above. (37 CFR 1.5)

A copy of this notice MUST be returned with this response.

Enclosed:	PCT/DO/EO/917	Notice of Defective Translation
	PTO-875	PCT/DO/EO/920

VONDA WALLACE

ENGLISH TRANSLATION OF EVIDENCES



[Evidence 1]

Request for signing the Declaration, Assignment, and Power of Attorney
regarding U.S. Patent Application

To proceed the PCT International Application, which was filed during your tenure of our company, in the national phase of United States of America, we would request for signing the Declaration, Assignment, and Power of Attorney regarding the U.S. Patent Application, which are mailed by separate mail, and for returning these documents to us by August 13, 2001.

Filing Number of the PCT International Application

PCT/JP00/07229

International Filing Date

October 18, 2000

Title of Invention

Polishing Machine for Peripheral Edge of Semiconductor

August 22, 2001

5, Asahigaoka, Kannabe-cho, Fukayasu-gun, Hiroshima-ken

Kabushiki Kaisha Ishii Hyoki

Yasuhiro Kozawa

4-7-9, Eda-Nisi, Aoba-ku, Yokohama-shi, Kanagawa-ken

Mr. Hitoshi Tambo

I hereby certify that this mail was in receipt as a contents-certified mail dated August 22, 2001, No.180-18 13812-1.

Postmaster of Goryo Post Office

[Evidence 2]

Delivery Certificate

Name of Recipient Mr. Hitoshi Tambo

Dealing Number 180-18-13812-1

This is to certify that this mail was delivered on August 26, 2001.

Kanagawa-ken Aoba Post Office

[Evidence 2-2]

Delivery Certificate

Name of Recipient Mr. Hitoshi Tambo

Dealing Number 180-18-13815-4

This is to certify that this mail was delivered on August 26, 2001.

Kanagawa-ken Aoba Post Office

[Evidence 3]

To Mr. Kozawa

I will return the documents without my sign, since there is no necessity for me to sign the documents.
Tambo 2001/9/19

evidence

A circular stamp from the Office of Intellectual Property (OIP). The text "OIP" is at the top, "JG128" is at the top right, "JUN 07 2002" is in the center, and "PATENT & TRADEMARK OFFICE" is at the bottom.

3.029
8-12
印

evidence 2

郵便物配達証明書

受取人の氏名	丹保 仁志 様
引受番号	180-18-13812-1
上記の郵便物は、13年8月26日配達したのでこれを証明します。	
神奈川県 葉郵便局 付 3.029 8-12 印	

ユ07370 (13.3・ヨンダ⑤納・03)

再生紙使用

3.029
8-12
印

郵便物配達証明書

受取人の氏名	丹保 仁志 様
引受番号	180-18-13813-2
上記の郵便物は、13年8月26日配達したのでこれを証明します。	
神奈川県 葉郵便局 付 3.029 8-12 印	

ユ07370 (13.3・ヨンダ⑤納・03)

再生紙使用

evidence 3.

小澤さん.

特許は、特許サインする必要もない

様なのでサインせずに送ります。

丹保

2001/9/9



SPECIFICATION

POLISHING MACHINE FOR PERIPHERAL EDGE OF SEMICONDUCTOR WAFER

5

BACKGROUND OF THE INVENTION

The present invention relates to a polishing machine for polishing the peripheral edge of a semiconductor wafer.

The peripheral edges of semiconductor wafers made
10 from silicon and the like are chamfered, but in recent years, further polishing of the peripheral edge has come to be conducted in order to prevent particle formation on the peripheral edge, imperfections arising during handling, and the like. Edge processing methods are known, for example,
15 a method for rotating a semiconductor wafer, and pressing a similarly rotating polishing pad thereto, while supplying polishing solution, as described in Japanese Patent Laid-Open Publication No. Hei. 11-104942, and a method for pressing a rotating polishing pad to a plurality of stacked
20 semiconductor wafers, while supplying polishing solution thereto, as described in Japanese Patent Laid-Open Publication No. Hei. 05-182939.

Chamfering processes of the peripheral edge of semiconductor wafers have had the following problems, due
25 to the fact that the chamfering radius is small and the

chamfering corners are steeply inclined: even with a flexible polishing pad it is unfeasible to obtain uniform contact with the surface of the peripheral edge, making it difficult to obtain highly precise polishing, and because
5 only a small part of the surface of the pad is in contact with the edge surface, for instance a point or a line, the polishing process is inefficient. Additionally, constant adjustments were required in order to maintain favorable polishing conditions, including changing the polishing pad
10 at appropriate intervals.

SUMMARY OF THE INVENTION

In light of the above, it is an object of the present invention to provide a polishing machine for a peripheral
15 edge of a semiconductor wafer, capable of highly precise, uniform, highly efficient, and stable polishing.

In order to achieve the above-mentioned object, the present invention provides a construction comprising: a rotary mechanism for holding a semiconductor wafer while
20 rotating it in a prescribed direction; a rotary body which rotates relative to the semiconductor wafer while maintaining a prescribed gap from a periphery thereof, having a rotary axis which is set in the same direction as the rotary axis of the semiconductor wafer; a polishing
25 solution channel for channeling the flow of polishing

solution to said gap; and a polishing solution supply portion for supplying polishing solution to the polishing solution channel.

Additionally, in order to achieve the above-mentioned
5 object, the present invention provides a construction comprising: a rotary mechanism for holding a semiconductor wafer while rotating it in a prescribed direction; a rotary body which rotates relative to the semiconductor wafer while maintaining a prescribed gap from a periphery thereof,
10 having a rotary axis which is set in the same direction as the rotary axis of the semiconductor wafer; a polishing solution tank for immersing the rotary mechanism and rotary body in polishing solution; and a polishing solution circulation portion for circulating the polishing solution
15 in and out of the polishing solution tank.

Since according to the present invention, contactless polishing is conducted by drawing polishing solution into the gap between the peripheral edge of semiconductor wafer and the rotary body, the peripheral edge of semiconductor
20 wafer can be polished in a highly precise and uniform manner. Additionally, because the polishing pad of existing methods is not needed, polishing pad changing and adjustments are not necessary, allowing for a stable polishing process.

25 In the above-mentioned construction, the rotary

mechanism holds one semiconductor wafer, or a plurality thereof in a stacked state. In the first case, the single semiconductor wafer held in the rotary mechanism is polished (the so-called single-wafer method), and in the
5 second case, the plurality of semiconductor wafers held in the rotary mechanism are polished in turn (the so-called batch method).

Additionally, in the above-mentioned construction, a dynamic pressure generating grooves can be formed on the
10 peripheral surface of the rotary body, facing the periphery of the semiconductor wafer. Because, according to this construction, the flow speed of polishing solution is increased through the dynamic pressure effect of the dynamic pressure generating grooves, the polishing
15 efficiency is increased.

Additionally, in the above-mentioned construction, a magnet may be installed in the rotary body, and a magnetic polishing solution may be used as the polishing solution. Because, according to this construction, the magnetic
20 polishing solution is confined by the magnet of the rotary body, the polishing efficiency is increased.

Additionally, in the above-mentioned construction, at least the peripheral surface of the rotary body facing the periphery of the semiconductor wafer may be formed of an
25 elastic material with a hardness in the range of 7 - 40 Hs.

The entire rotary body may be formed of an elastic material having a hardness of 7 - 40 Hs, and only the outer surface layer of the rotary body, including the peripheral surface, may be formed of an elastic material having a hardness of 7
5 - 40 Hs. The elastic material having a hardness of 7 - 40 Hs may be, for example, a rubber such as chloroprene rubber, or alternatively a synthetic resin formed into a porous (spongy) state by such means as expansion molding. The term "Hs" used here refers to hardness as measured by a
10 JIS-standard Type A spring hardness tester (used to measure the hardness of rubber). This is widely used to express the hardness of a material in order to evaluate the elasticity of such elastic materials as rubber.

In the polishing machine of the present invention,
15 the polishing efficiency and coarseness of the polished surface are influenced by such factors as polishing speed (the relative rotating speed of the semiconductor wafer and the rotary body), the flow speed and pressure of polishing solution in the above-mentioned gaps, the viscosity of the
20 polishing solution, and the concentration and diameter of abrasive particles in the polishing solution. However, by forming at least the peripheral surface of the rotary body from an elastic material with a hardness of 7 - 40 Hs, variations in the values of the above-mentioned factors are
25 absorbed by the appropriate elasticity of the rotary body

peripheral surface, making it possible to constantly obtain a stable polishing efficiency and level of polished surface coarseness. Additionally, during the polishing process, the polishing speed may be changed (for example, polishing
5 with a relatively high polishing speed for a prescribed length of time from the start of the polishing process, then polishing at a relatively lower polishing speed for the remainder of the polishing process) without changing the semiconductor wafer holding status, the polishing
10 solution, or the like, enabling highly precise, highly efficient polishing.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a polishing machine
15 for a peripheral edge of a semiconductor wafer according to a first embodiment of the present invention.

Fig. 2 shows the polishing surface of the polishing mechanism according to the first embodiment of the present invention.

20 Fig. 3 shows the operational states of the polishing mechanism according to the first embodiment of the present invention.

Fig. 4 shows an example of the polishing machine according to the first embodiment of the present invention,
25 using differently shaped spacers.

Fig. 5 is a perspective view of a polishing machine for a peripheral edge of a semiconductor wafer according to a second embodiment of the present invention.

Fig. 6 is a perspective view of a polishing machine
5 for a peripheral edge of a semiconductor wafer according to a third embodiment of the present invention.

Fig. 7 shows a magnetic polishing mechanism of a polishing machine for a peripheral edge of a semiconductor wafer according to a fourth embodiment of the present
10 invention.

Fig. 8 is a perspective view of a polishing machine for a peripheral edge of a semiconductor wafer according to a fifth embodiment of the present invention.

15 DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the current invention will be described in detail below, making reference to the drawings.

As shown in Fig. 1, the polishing machine for a
20 peripheral edge of a semiconductor wafer according to the first embodiment of the present invention comprises a rotary mechanism 2 on which is mounted and rotated a stack 1 of semiconductor wafers 4, and a polishing mechanism 3 which can be moved as desired along the radial direction of
25 the rotary mechanism 2, and which polishes the peripheral

edges of the rotating semiconductor wafers 4 via a contactless polishing process.

The peripheral edges of semiconductor wafers 4, having for example the shapes of circular plates, are
5 chamfered as necessary, and notches (omitted from the drawing) are formed on the periphery at prescribed locations. The stack 1 of the semiconductor wafers 4 is aligned with the notches, and formed by placing spacers 5 between each semiconductor wafer 4. Note that the stack 1
10 of semiconductor wafers 4 is preferably provided with spacers 5 on the top and the bottom thereof, in order to keep from marking the surface of the wafers 4 when the stack 1 is locked into the rotary mechanism 2.

Rotary mechanism 2 comprises a turntable 6 on which
15 is mounted the stack 1 of semiconductor wafers 4, and a locking piece 7 for pressing the stack 1 of semiconductor wafers 4 onto the turntable 6.

Polishing mechanism 3 has as the chief elements of its construction a housing 11, and a rotary body freely
20 rotating and accommodated in the housing 11, for example a rotary column 10. This polishing mechanism 3 is mounted on a slide rail 8 installed in the radial direction of the rotary mechanism 2, and can move freely along the slide. Additionally, the elasticity means not shown in the drawing
25 constantly presses the polishing mechanism 3 against the

rotary mechanism 2 in the direction of the rotary mechanism 2 center through a prescribed level of elastic pressure.

As shown in Fig. 2, the housing 11 is provided with a contact surface 13, for example an approximately

5 rectangular parallelepiped member on the side facing the rotary mechanism 2. The contact surface 13 contacts the periphery of the stack 1 along the contour of the outer surface thereof. The contact surface 13 has a curved inner side shape in order to conform to the outer shape of the
10 stack 1 of semiconductor wafers 4. An aperture 12 is formed on the contact surface 13 in order to expose the rotary column 10 inside the housing 11. The periphery of the aperture 12 is sealed in order to keep the polishing solution from leaking.

15 The rotary column 10, for example a cylindrical member formed from metal or other materials having necessary rigidity, is accommodated within the housing 11 so that it can rotate freely, rotating on the vertical axis under the power of freely chosen rotary drive means. The
20 outer surface 10a of the rotary column 10 is exposed at the aperture 12, and the polishing solution flow channel 9 narrows at the aperture 12. As shown in Fig. 3, the rotary column 10 faces the stack 1 at the aperture 12 via a minute gap s, and rotates in the opposite direction relative
25 thereto.

As shown in Fig. 3, the housing 11 is equipped with the polishing solution flow channel 9 which channels polishing solution via the gap s of the aperture 12. The polishing solution flow channel 9 runs through the gap s of the aperture 12 at either side, and has a supply channel 14 and a drain channel 15 shown on the right and left sides of the drawing.

The polishing solution, for example an aqueous solution including polishing abrasive particles, is pressure-fed down the supply channel 14 using prescribed levels of pressure and heat, by means of an external pump and heat exchanger (omitted from the drawing). The polishing solution then flows from the supply channel 14 to the drain channel 15 by way of the gap s, forming in its totality the polishing solution flow channel 9.

A spring mounted on the slide rail 8 (omitted from the drawing) presses the polishing mechanism 3 against the stack 1 of semiconductor wafers 4. This absorbs differences in the diameters of the stack 1 and rotary column 10 and rotary vibration when the polishing machine for a peripheral edge is operated, ensuring contact between the contact surface 13 and stack 1, maintaining the appropriate size of the above-mentioned minute gap s, and preventing the leakage of polishing solution from the contact surface 13.

Then, because the polishing solution flow channel 9 narrows at the minute gap s, the flow speed and pressure of polishing solution passing therethrough increases, and the polishing abrasive particles collide with the peripheral edges of the semiconductor wafers 4 at a nearly flat angle. This enables the polishing mechanism 3 to polish the peripheral edges of the semiconductor wafers 4 with a high level of precision by destroying minute quantities thereof. Additionally, since this polishing machine polishes by causing polishing abrasive particles to collide with the edges during the flow of polishing solution, it is possible to uniformly polish the peripheral edges.

The above has described the first embodiment of the polishing machine for a peripheral edge, but this embodiment may be modified in a number of ways.

For example, as shown in Fig. 4, the diameter of the spacer 5 may be slightly made larger than that of the semiconductor wafer 4, to form a prescribed minute gap s between the peripheral edges of the semiconductor wafers 4 and the rotary column 10 by causing the spacers 5 to contact the rotary column 10. Additionally, grooves 16 may be formed around the circumference of the spacers 5 in conformity with the edges of the chamfered portions of the semiconductor wafers 4, in order to uniformly draw polishing solution in around the entire edges of the

semiconductor wafers 4. Additionally, in the above-mentioned embodiment, the rotary axis of the rotary mechanism 2 which rotates the stack of semiconductor wafers 4 is set up along the vertical axis. However, the rotary axis of the rotary mechanism (the rotary axis of the semiconductor wafers 4) may be set up along the horizontal axis, and the related apparatuses may be arranged to correspond thereto.

Additionally, the polishing mechanism 3 does not only move along the radial direction of the stack 1 of semiconductor wafers 4, but is also provided with a mechanism which can move along the periphery of the stack 1 of semiconductor wafers 4. Moreover, the polishing solution may include surfactants and viscosity modifiers, and it is also permissible to modify the diameter of the polishing abrasive particles in a stepwise or continuous manner, in accordance with the process in question to perform sequentially coarse processing to finishing without removing a work. In addition, it is possible to use a polishing solution having mechanochemical polishing effects which includes chemically active solid particles or chemical solutions, or to use a polishing solution whose polishing abrasive particles themselves have mechanochemical polishing effects. It is also possible to form grooves on the surface of the rotary column 10,

parallel to the rotary axis or in a spiral configuration,
as dynamic pressure generating grooves in order to increase
the flow speed of polishing solution at the gap between the
rotary column 10 and semiconductor wafers 4, to form a
5 textured surface, to form a hydrophilic membrane on the
surface of the rotary column 10, or to construct the rotary
column 10 from a porous material. Alternatively, it is
possible to take a replica of the peripheral edge of a
wafer using a softened polymer material, and use this as
10 the rotary column 10.

Next, a polishing machine for a peripheral edge of a
semiconductor wafer according to the second embodiment of
the present invention will be described.

As shown in Fig. 5, the polishing machine for a
15 peripheral edge of a semiconductor wafer according to this
embodiment is made up of the entire polishing machine for a
peripheral edge of the first embodiment, immersed in a
polishing solution tank 21 filled with polishing solution.

The polishing solution tank 21 is equipped with a
20 polishing solution circulation apparatus 25. The polishing
solution circulation apparatus 25 has two communicating
pipes: a supply pipe 22 installed in the upper portion of
the polishing solution tank 21, and a drain pipe 23
installed in the lower portion thereof, and circulates
25 polishing solution in and out of the polishing solution

tank 21. The polishing solution is collected from the lower portion of the polishing solution tank 21 by the polishing solution circulation apparatus 25, and after its temperature is regulated inside the heat exchanger 26, it
5 is again supplied to the upper portion of the polishing solution tank 21.

The semiconductor wafers 4 are stacked, sandwiched by spacers 5, in the same manner as the first embodiment. In the approximate center of the polishing solution tank 21 is
10 installed a rotary mechanism 2, which rotates the stack 1 of semiconductor wafers 4 mounted thereon. As in the first embodiment, the rotary mechanism 2 is equipped with a turntable 6 on which is mounted the stack 1 of semiconductor wafers 4, and a locking piece 7 which presses
15 the stack 1 of semiconductor wafers 4 against the turntable 6, and fixes it in place. A slide rail 8 is installed in the radial direction of the rotary mechanism 2. The slide rail 8 axially supports a rotary column 10 which is freely movable. The rotary column 10 is constructed so as to
20 rotate with the stack 1 of semiconductor wafers 4, mediated by a minute gap s.

In this polishing machine for a peripheral edge, the rotary mechanism 2 upon which is mounted the stack 1 of semiconductor wafers 4 and the rotary column 10 rotate in
25 the opposite direction relative to each other, in a state

in which polishing solution has penetrated therebetween. The polishing solution is drawn into the space between the relatively rotating stack 1 of semiconductor wafers 4 and rotary column 10 by means of viscosity. Fluid mechanics
5 cause the speed of the polishing solution to increase as it is drawn into the minute gap s, due to the narrowing thereof. Then, when the polishing abrasive particles in the polishing solution pass through the minute gap s, they collide with the peripheral surfaces of the semiconductor
10 wafers 4 at a nearly flat angle, polishing the peripheral edges thereof.

In other words, in the same manner as the polishing machine for a peripheral edge of the first embodiment, this polishing machine for a peripheral edge is able to polish
15 the peripheral edges of the semiconductor wafers 4 with a high level of precision by destroying minute quantities thereof.

It is also permissible to form grooves on the surface of the rotary column 10 of this polishing machine for a
20 peripheral edge, parallel with the rotary axis or in a spiral configuration, or process it to give it a textured surface. Additionally, it is possible to form a hydrophilic membrane on the surface of the rotary column 10, or to construct the rotary column 10 from a porous material.
25 The shapes of the flow channel cover and/or polishing

solution tank 21 may be changed in order to minimize the flow of polishing solution circulating therein.

Additionally, in the present embodiment the diameter of the spacer 5 may be slightly made larger than that of the semiconductor wafer 4 to form a prescribed minute gap s between the peripheries of the semiconductor wafers 4 and the periphery of the rotary column 10 by causing the spacers 5 to contact the rotary column 10.

Next, a polishing machine for a peripheral edge of a semiconductor wafer according to the third embodiment of the present invention will be described.

As shown in Fig. 6, in this polishing machine for a peripheral edge, a rotary mechanism 2 upon which is mounted a stack 1 of semiconductor wafers 4, and an interior pipe body 32 mounted on the periphery of the stack 1 of semiconductor wafers 4, are accommodated inside an approximately cylindrical exterior pipe body 31 installed on the base thereof. Polishing solution is drawn into the minute gap between the stack 1 of semiconductor wafers 4 and interior pipe body 32, polishing the peripheral edges of the semiconductor wafers 4.

As in the first embodiment, the rotary mechanism 2 is equipped with a turntable 6 upon which is mounted the stack 1 of semiconductor wafers 4, and a locking piece 7 which presses the stack 1 of semiconductor wafers 4 onto the

turntable 6, and fixes it thereto.

The exterior pipe body 31 serving as a polishing solution supply portion is affixed to the base so as to be on the same axis as the rotary mechanism 2. The exterior
5 pipe body 31 is equipped with a storage portion 33 in order to create a space between it and the interior pipe body 32, and store polishing solution. In the interior of the exterior pipe body 31, the upper end 33a and lower end 33b are sealed in order to prevent leakage of the polishing
10 solution from the storage portion 33. The side of the exterior pipe body 31 is equipped with a supply pipe 34 for supplying polishing solution, and a drain pipe 35 for draining the polishing solution. Polishing solution of a prescribed pressure is supplied to the storage portion 33
15 via the supply pipe 34 from a polishing solution supply apparatus (omitted from the drawing).

The interior pipe body 32, serving as a rotary column, is accommodated between the exterior pipe body 31 and the stack 1 of semiconductor wafers 4, and rotated by a rotary
20 mechanism not shown in the drawing. The inner surface 35 of the interior pipe body 32 faces the peripheral surface of the stack 1 of semiconductor wafers 4 mediated by a minute gap. Vertically aligned dynamic pressure grooves 36 formed on the inner surface 35 of the interior pipe body 32
25 are distributed around the periphery at prescribed

intervals. The dynamic pressure grooves 36 are equipped with a plurality of polishing solution supply apertures 37 which are linked to the storage portion 33 of the exterior pipe body 31, in order to supply polishing solution to the interior of the interior pipe body 32 .

This polishing machine for a peripheral edge rotates the stack 1 of semiconductor wafers 4 by means of the rotary mechanism 2 and rotates the interior pipe body 32 in the opposite direction relative to the stack 1 of semiconductor wafers 4, while supplying polishing solution at a prescribed pressure to the exterior pipe body 31. At this time, dynamic pressure generated between the stack 1 of semiconductor wafers 4 and interior pipe body 32 draws polishing solution between the inner surface 35 of the interior pipe body 32 and the stack 1 of semiconductor wafers 4 from the dynamic pressure grooves 36 of the interior pipe body 32.

The flow speed and pressure of the polishing solution drawn between the inner surface 35 of the interior pipe body 32 and the stack 1 of semiconductor wafers 4 is accelerated due to the narrowing of the flow channel therebetween. Additionally, due to the fact that the polishing solution flows around the peripheries of the semiconductor wafers 4, the polishing abrasive particles in the polishing solution pass collide with the peripheral

surfaces of the semiconductor wafers 4 at a nearly flat angle, polishing the peripheral edges thereof. In other words, in the same manner as the polishing machine for a peripheral edge of the first embodiment, this polishing
5 machine for a peripheral edge is able to polish the peripheral edges of the semiconductor wafers 4 with a high level of precision by destroying minute quantities thereof.

The dynamic pressure grooves 36 formed on the interior pipe body 32 may be wedge-shaped, in order to
10 obtain a greater fluid-mechanical effect. Additionally, it is permissible to form a hydrophilic membrane on the surface of the interior pipe body 32, process it to give it a textured surface, or construct the interior pipe body 32 from a porous material. Moreover, as in the second
15 embodiment, a construction in which the entire apparatus is immersed in polishing solution may be employed. Moreover, the rotary axis of the stack 1 of semiconductor wafers 4 may be given a horizontal construction and the related apparatuses may be arranged to correspond thereto. It is
20 also permissible to employ a construction which locks the exterior pipe body 31 and interior pipe body 32 in place, and rotates the stack 1 of semiconductor wafers 4, and in this case, it is also permissible if the interior and exterior pipes do not completely enclose the wafers, or if
25 they are notched.

It is also possible for the components adjacent to the semiconductor wafers 4 of the polishing machine for a peripheral edge of the above-mentioned embodiments 1 - 3 to be formed from high-purity silicon or high-purity quartz.

5 Additionally, the rotary column 10 and/or interior pipe body 32 may be made of, for example, polyurethane.

With the above-mentioned construction, the components of the polyurethane rotary column 10 or interior pipe body 32 that are adjacent to the stack 1 of semiconductor wafers 10 4 are deformed in conformity with the peripheral shape of the stack 1, and form a minute gap s together with the semiconductor wafers 4 within the polishing solution. Then, polishing solution is drawn between it and the stack 1 of semiconductor wafers 4, generating a high-speed fluid 15 bearing-type flow. At this time, the polishing abrasive particles included in the fluid collide with the surface of the semiconductor wafers 4, achieving high-precision polishing by destroying minute quantities thereof.

For example, in an embodiment in which the rotary 20 column 10 is made of polyurethane, if the rotary column 10 is pressed against the periphery of the stack 1 of semiconductor wafers 4, then it is easy to establish a minute gap s, since the shape thereof is freely changed to conform to the shape of the periphery of the stack 1 of 25 semiconductor wafers 4 and a minute gap is formed between

it and the semiconductor wafers 4.

Alternatively, it is possible to form the rotary column 10 in its entirety, or the surface portion including the peripheral surface 10a thereof, of a rubber such as chloroprene rubber, or alternatively a synthetic resin formed into a porous (spongy) state, using an elastic material with a hardness of 7 - 40 Hs. Even if there are fluctuations in polishing speed (the relative rotary speed of the semiconductor wafer and rotary body), the flow speed and pressure of the polishing solution inside the minute gaps, viscosity of the polishing solution, and the concentration and diameters of the abrasive particles included in the polishing solution, it is possible to constantly obtain a stable polishing efficiency and polishing surface grain, since these fluctuations are absorbed by the appropriate elasticity of the peripheral surface 10a of the rotary column 10. Additionally, during the polishing process, the polishing speed may be changed (for example, polishing with a relatively high polishing speed for a prescribed length of time from the start of the polishing process, then polishing at a relatively lower polishing speed for the remainder of the polishing process) without changing the semiconductor wafer holding status, the polishing solution, or the like, enabling highly precise, highly efficient polishing.

Next, a polishing machine for a peripheral edge of a semiconductor wafer according to a fourth embodiment of the present invention will be described.

As shown in Fig. 7, although the basic construction
5 of the polishing machine for a peripheral edge of this embodiment is the same as that of the polishing machine for a peripheral edge of the first embodiment, unlike the polishing machine for a peripheral edge of the first embodiment, this embodiment is equipped with a magnetic
10 polishing mechanism 41 having n-polar 44 and s-polar 45 magnets arrayed in alternation around the periphery of the outer surface of the rotary column 42, and using magnetic polishing solution including polishing abrasive particles in the magnetic fluid.

15 Since magnets 44 and 45 are installed in the outer surface of the rotary column 42, the magnetically charged magnetic polishing solution is drawn by the magnetic fields of the magnets 44 and 45 of the rotary column 42. Then, by rotating the stack 1 of semiconductor wafers 4 and the
20 rotary column 42 in opposite directions relative to each other, the magnetic polishing solution is drawn into the minute gap s of the polishing solution flow channel 46 along the surface of the rotary column 42. This enables high-precision polishing of the peripheral edges of the
25 semiconductor wafers 4 by destroying minute quantities

thereof, in the same manner as the polishing machine for a peripheral edge of the first embodiment.

This polishing mechanism 41 may be constructed in such a manner that it does not only move in the radial
5 direction of the stack 1 of semiconductor wafers 4, but also moves in the peripheral direction along the circular periphery thereof. Moreover, the magnetic polishing solution may contain surfactants and viscosity modifiers. In addition, a polishing solution having mechanochemical
10 polishing effects which includes chemically active solid particles or chemical solutions, or a polishing solution whose polishing abrasive particles themselves have mechanochemical polishing effects may be used. It is also possible to form grooves on the surface of the rotary
15 column 42, parallel to the axis or in a spiral configuration, as dynamic pressure grooves in order to increase the flow speed of magnetic polishing solution through the minute gap s by means of a fluid-mechanical effect. It is also possible to form a hydrophilic membrane
20 on the surface of the rotary column 42.

In the embodiment shown in Fig. 7, the outer diameter of the spacer 5 is slightly made larger than that of the semiconductor wafer 4 to contact the rotary column 42 with the peripheries of the spacers 5, forming a minute gap
25 between the rotary column 42 and semiconductor wafers 4.

Additionally, grooves 47 are provided in the peripheral direction of the spacers 5, so that the magnetic polishing solution flows uniformly along the edges of the semiconductor wafers 4.

5 Note that in Fig. 7, although the rotary axis of the rotary mechanism is set up along the vertical axis, the rotary axis of the rotary mechanism may be set along the horizontal axis, and the related apparatuses may be arranged to correspond thereto. Moreover, it is also
10 possible to employ a construction immersing the entire apparatus in magnetic polishing solution, in the same manner as the second embodiment.

Next, a polishing machine for a peripheral edge of a semiconductor wafer according to the fifth embodiment of
15 the present invention will be described.

As shown in Fig. 8, in the polishing machine for a peripheral edge of this embodiment, a rotary mechanism 2 upon which is mounted a stack 1 of semiconductor wafers 4 and an interior pipe body 52 surrounding the stack 1 of
20 semiconductor wafers 4 are accommodated within a generally cylindrical exterior pipe body 51 installed on the base thereof. Note, however, that in the present embodiment, an interior pipe body 52 is used which has n-polar 54 and s-polar 55 magnets arrayed in alternation around the
25 periphery of the inner surface thereof, and a magnetic

polishing solution is used including polishing abrasive particles in magnetic fluid.

The exterior pipe body 51, in the same manner as the exterior pipe body 31 according to the third embodiment, is
5 equipped with an internal storage portion 56, a supply pipe 57 that supplies magnetic polishing solution at a prescribed pressure to a storage portion 56 from a magnetic polishing solution supply apparatus not shown in the drawing, and a drain pipe 58 that drains magnetic polishing
10 solution from the storage portion 56.

This polishing machine for a peripheral edge rotates a stack 1 of semiconductor wafers 4 by means of a rotary mechanism 2, and rotates an interior pipe body 52 by means of the rotary mechanism 2 not shown in the drawing in the
15 direction opposite to that of the stack 1 of semiconductor wafers 4, while supplying the magnetic polishing solution with a predetermined pressure into the exterior pipe body 51.

Magnetic polishing solution is supplied to the gap
20 between the interior pipe body 52 and the stack 1 of semiconductor wafers 4 from a plurality of supply apertures 59 in the interior pipe body 52. Then, the magnetic polishing solution is drawn by the magnets 54 and 55 installed in the inner surface of the interior pipe body 52,
25 and drawn into the gap between the interior pipe body 52

and stack 1 of semiconductor wafers 4 which are rotating opposite relative one another.

At this time, since the polishing abrasive particles in the magnetic polishing solution collide with the peripheral edges of the semiconductor wafers 4 at a nearly flat angle, it is possible to conduct high-precision polishing of the peripheral edges of the semiconductor wafers 4 by means of a minute-quantity destruction effect.

Note that in order to increase the speed of the magnetic polishing solution flow at the gap between the interior pipe body 52 and the semiconductor wafers 4 through a fluid-mechanical effect, it is possible to form grooves on the inner surface of the interior pipe body 52 parallel to the rotary axis thereof or in a spiral configuration, as dynamic pressure grooves, and it is also possible to make these grooves wedge-shaped in order to obtain a greater fluid-mechanical effect.

The above has described embodiments of the present invention, but the present invention is not limited to these embodiments. For example, in the stack of semiconductor wafers, wafers are stacked sandwiched by spacers, but the form is not limited to a stack of semiconductor wafers. Additionally, the constructions of embodiments 1 to 6 may be combined as desired. Furthermore, although in the embodiments described above a plurality of

semiconductor wafers are simultaneously polished using the so-called batch method, it is also possible to use a construction in which the rotary mechanism holds and rotates a single semiconductor wafer, polishing a single semiconductor wafer at a time (the so-called single-wafer method).

CLAIMS

1. A polishing machine for a peripheral edge of a semiconductor wafer, said machine comprising:

5 a rotary mechanism for holding a semiconductor wafer while rotating it in a prescribed direction;

 a rotary body which rotates relative to the semiconductor wafer while maintaining a prescribed gap from a periphery of said semiconductor wafer, having a rotary
10 axis which is set in the same direction as the rotary axis of said semiconductor wafer;

 a polishing solution channel for channeling the flow of polishing solution to said gap; and

 a polishing solution supply portion for supplying the
15 polishing solution to said polishing solution channel.

2. A polishing machine for a peripheral edge of a semiconductor wafer, said machine comprising:

 a rotary mechanism for holding a semiconductor wafer
20 while rotating it in a prescribed direction;

 a rotary body which rotates relative to the semiconductor wafer while maintaining a prescribed gap from a periphery of said semiconductor wafer, having a rotary
 axis which is set in the same direction as the rotary axis
25 of said semiconductor wafer;

a polishing solution tank for immersing said rotary mechanism and said rotary body in polishing solution; and

a polishing solution circulation portion for circulating the polishing solution in and out of said

5 polishing solution tank.

3. The polishing machine for a peripheral edge of a semiconductor wafer according to claim 1 or 2, wherein said rotary mechanism holds a plurality of semiconductor wafers
10 in a stacked state.

4. The polishing machine for a peripheral edge of a semiconductor wafer according to claim 1 or 2, wherein dynamic pressure generating grooves are formed on the
15 peripheral surface of said rotary body facing the periphery of said semiconductor wafer.

5. The polishing machine for a peripheral edge of a semiconductor wafer according to claim 1 or 2, wherein a
20 magnet is installed in said rotary body and a magnetic polishing solution is used as said polishing solution.

6. The polishing machine for a peripheral edge of a semiconductor wafer according to claim 1 or 2, wherein at
25 least the peripheral surface of said rotary body facing the

periphery of said semiconductor wafer is formed of an
elastic material with a hardness in the range of 7 - 40 Hs.

ABSTRACT

A polishing machine for a peripheral edge of a semiconductor wafer comprises a rotary mechanism 2 which rotates a stack 1 of semiconductor wafers 4 mounted thereon, and a polishing mechanism 3 which is arranged to be movable in the radial direction of the rotary mechanism 2 and polishes the peripheral edges of the rotating semiconductor wafers 4 by means of contactless polishing. Minute gaps s are formed between the rotary column 10 of the polishing mechanism 3 and the stack 1 of semiconductor wafers 4, and polishing solution is drawn into these minute gaps s. The peripheral edges of the semiconductor wafers 4 are polished by means of contactless polishing, using polishing abrasive particles included in polishing solution.

FIG. 1

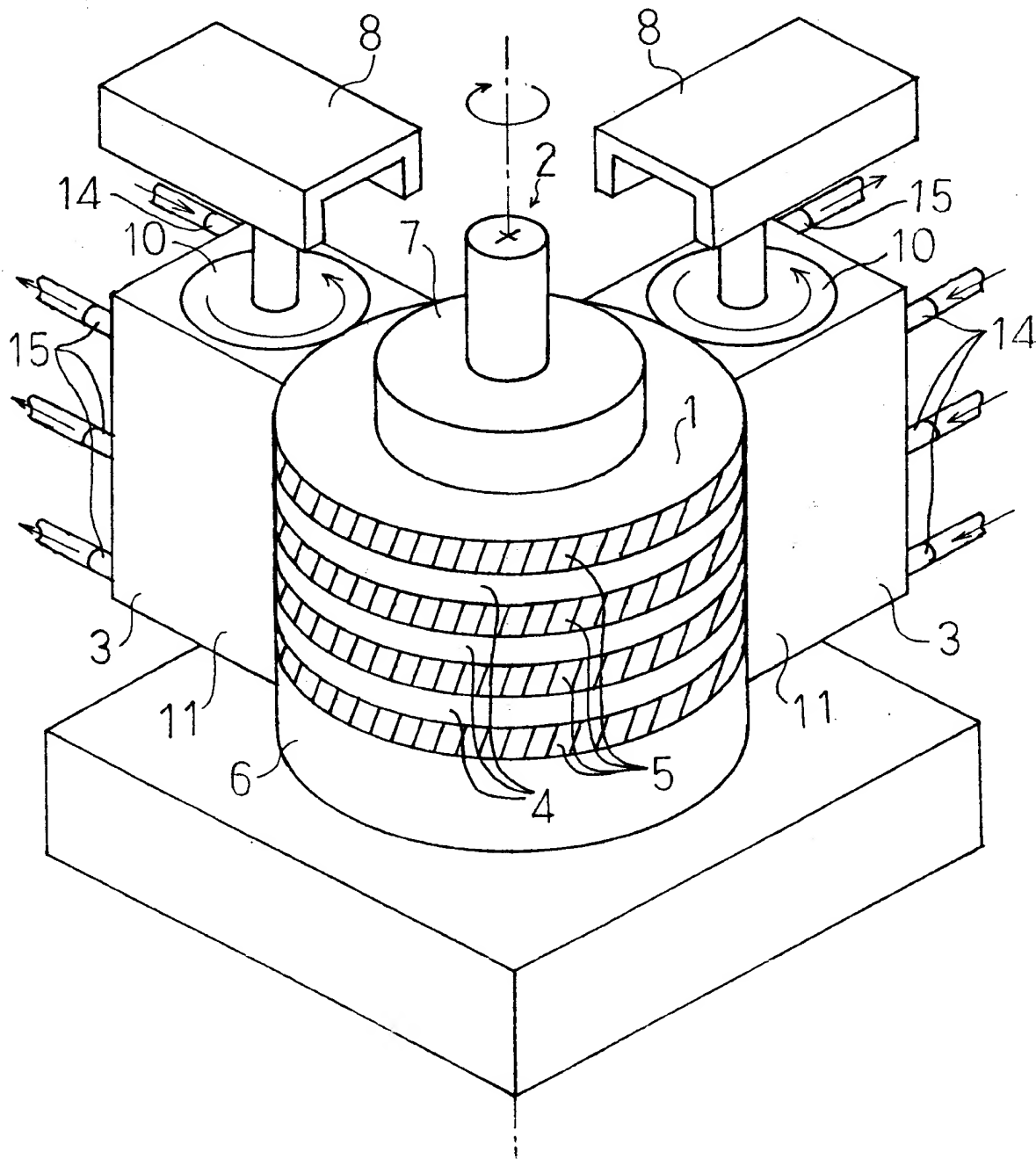
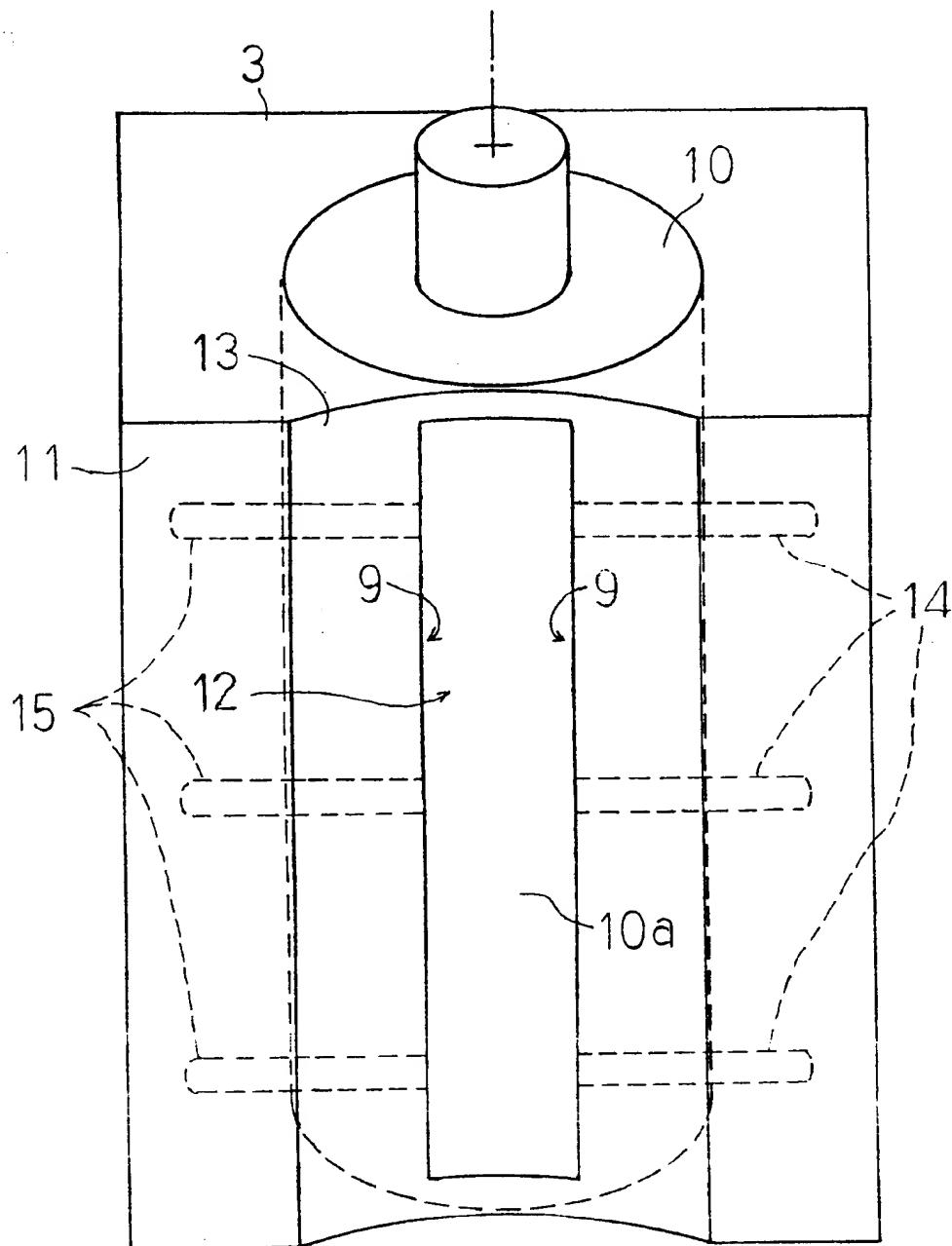
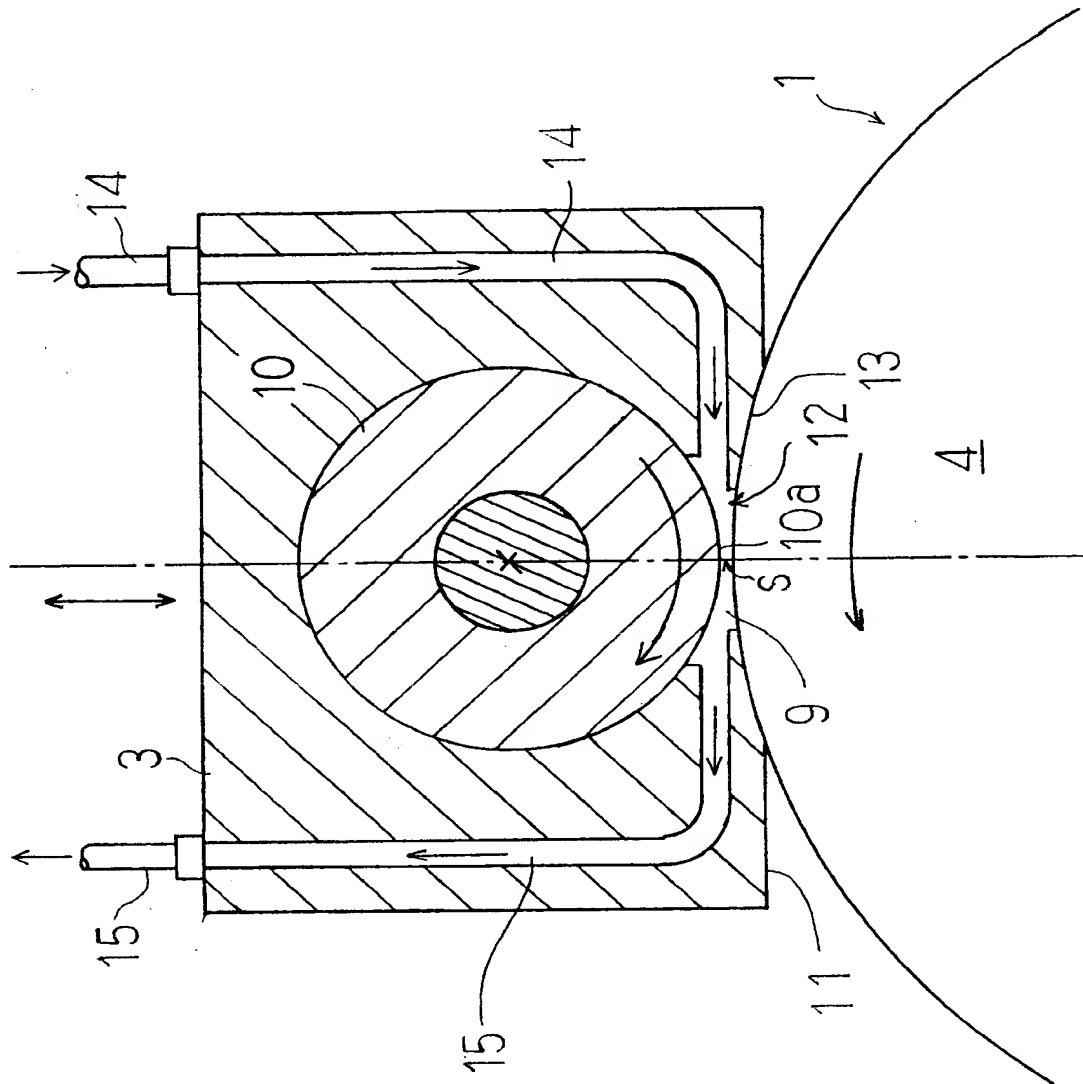


FIG. 2



F. I G. 3



F I G. 4

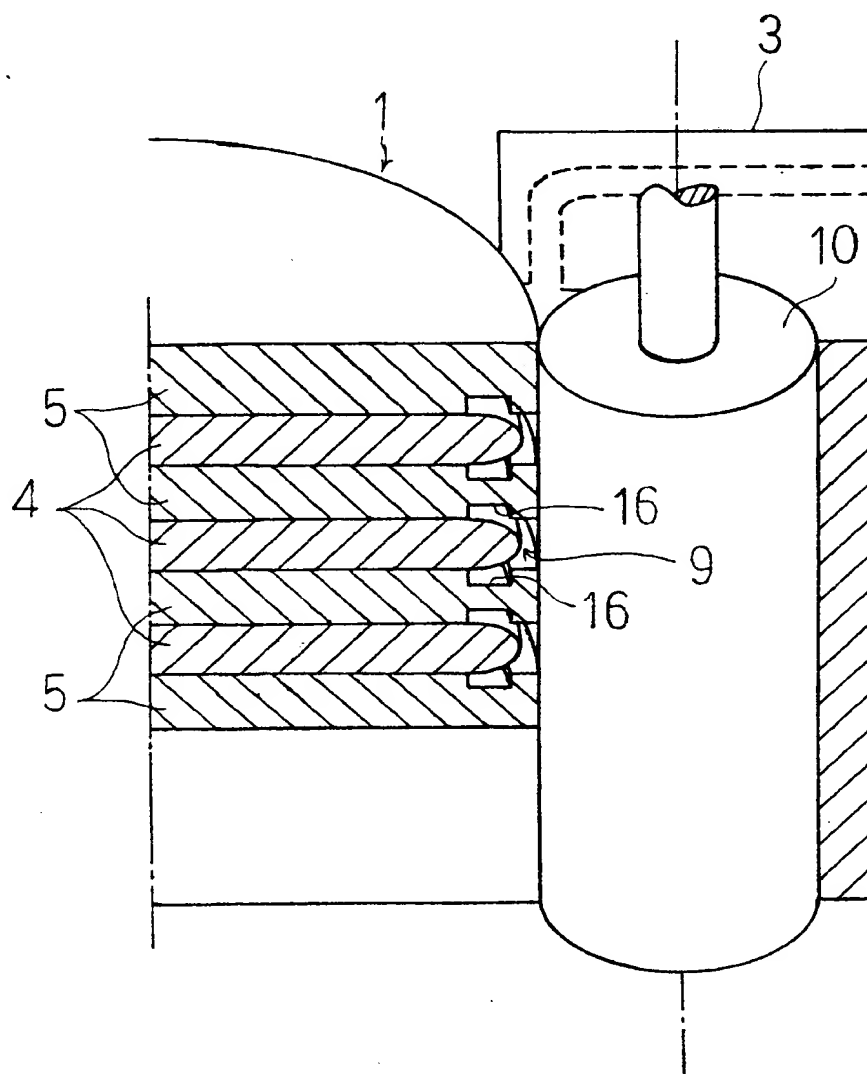


FIG. 5

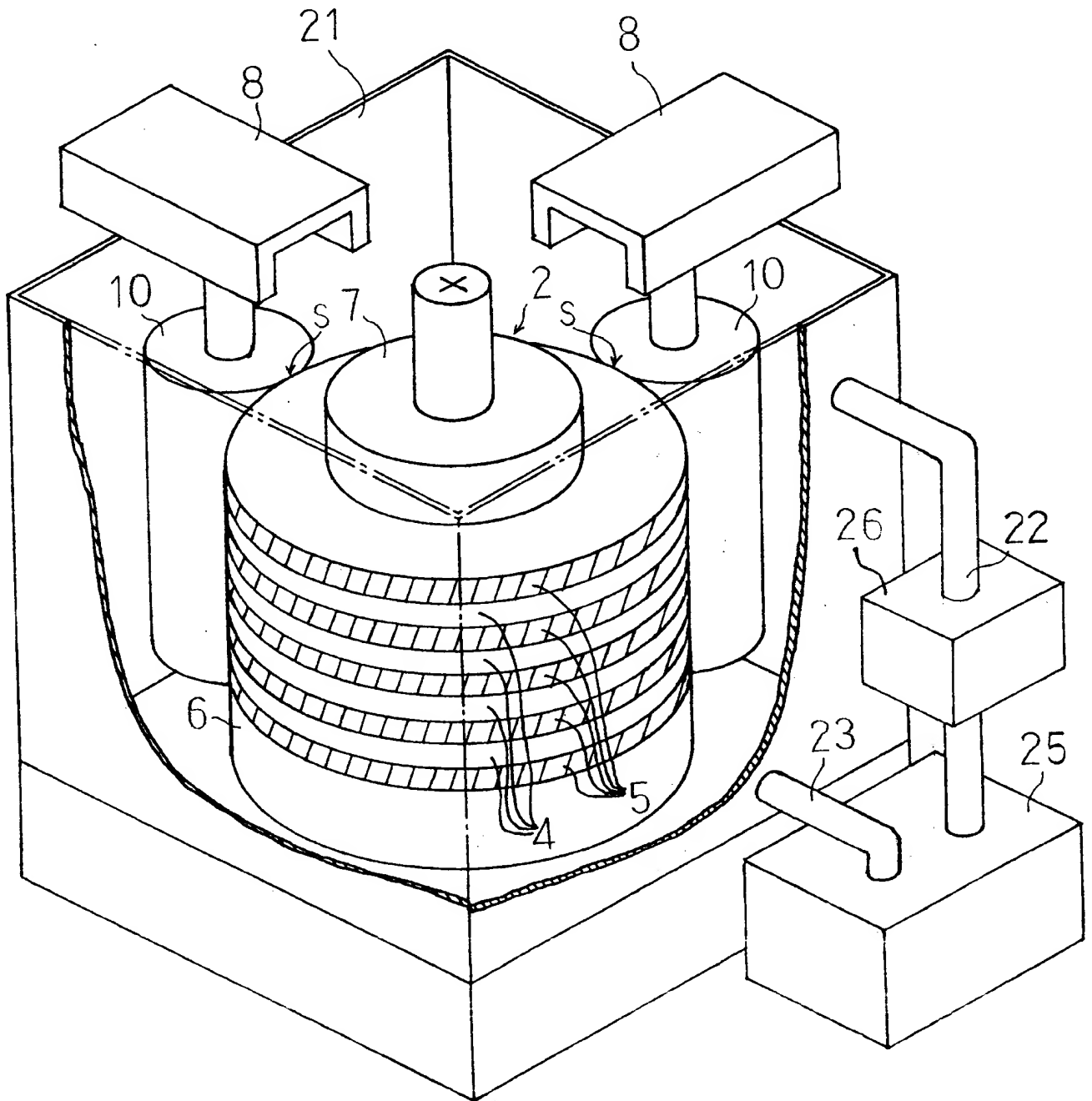


FIG. 6

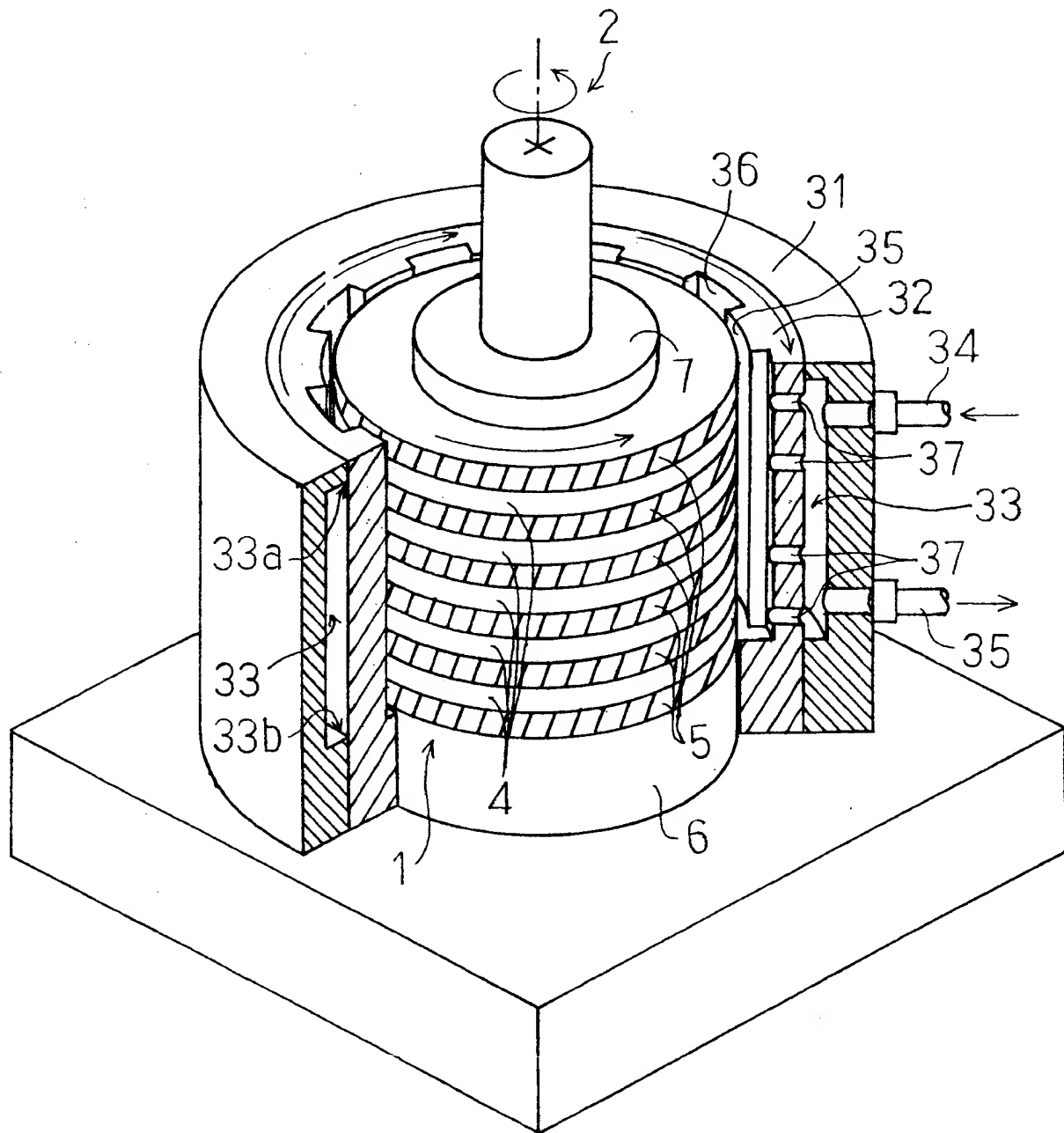


FIG. 7

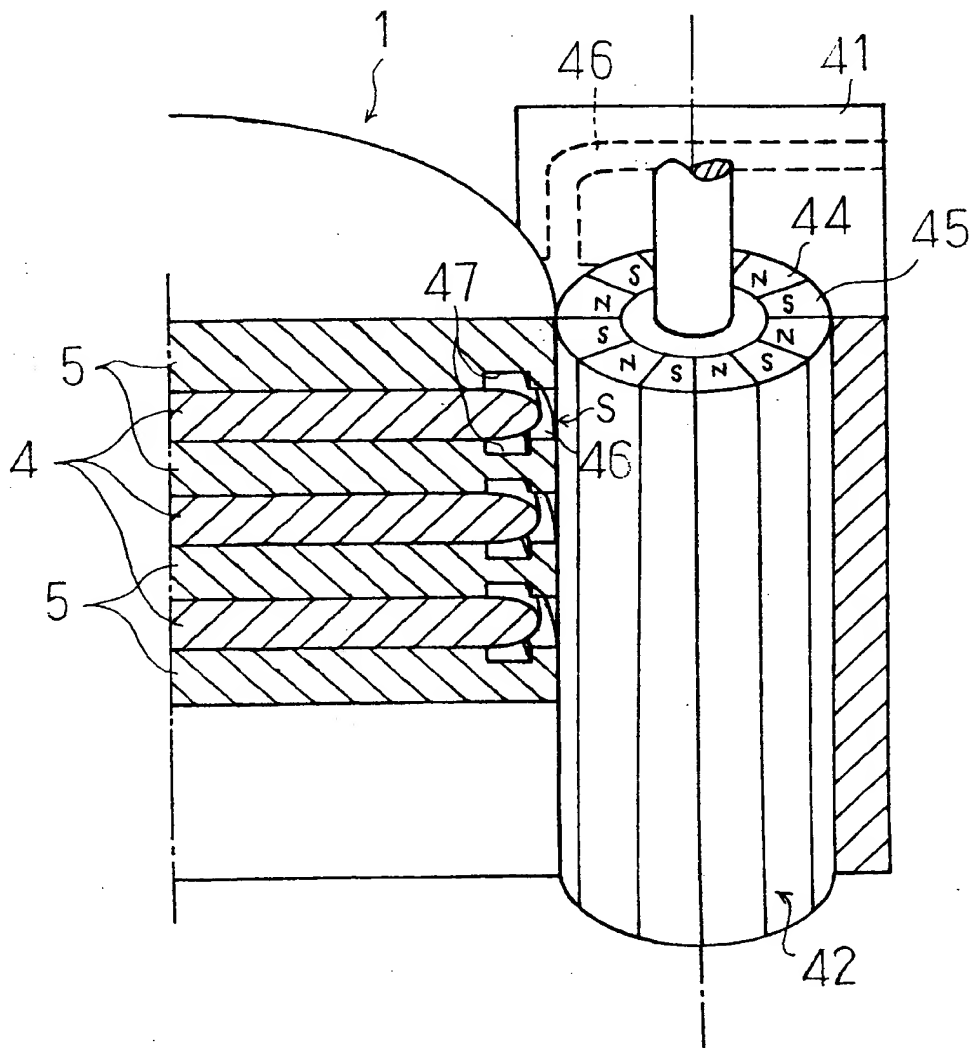


FIG. 8

